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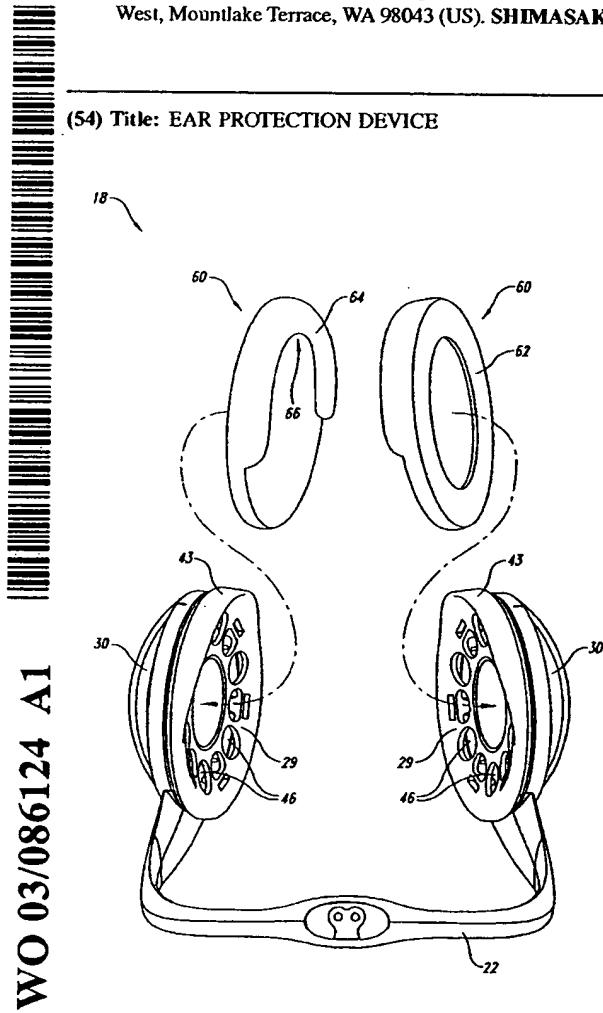
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[Continued on next page]

(54) Title: EAR PROTECTION DEVICE



(57) Abstract: An ear protection device (18) that includes a pair of ear protectors (30), each ear protector (30) having a pocket (64) associated therewith that is sized and shaped to be received over the top of the user's ear to support the device (18) on the ear; and a band (22) connected to the pair of ear protectors (30), the band (22) formed of lightweight resilient material and configured to position the ear covers in alignment with the user's ears and with the pockets (64) positioned over the tops of the respective ears. A selectively positionable door (30) is provided on the exterior of each ear protector (30) to cover and uncover an opening in each protector to facilitate the passage of sound to the user's ear through the ear cover when the door (30) is in an opened position.

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EAR PROTECTION DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is directed to a device for protecting the 5 ears of the user, and more particularly to a lightweight ear protection device that is supported by the ears and protects the ears from the elements while facilitating the user's ability to hear.

Description of Related Art

Conventionally, ear muffs and the like have been provided with 10 ear pieces at each end of a headband, with the ear pieces then being worn with the headband put around the top of the head or around the base of the head region of the head. Figure 1 shows an example a known headband that wraps around the back of the head. Here, the article 10 comprises two ear pieces 16 (with only one being shown in Figure 1) and a headband 14 clamping the ear 15 pieces 16 at each end to the user's head 12. The headband 14 is constructed of flexible material, for example, a plastic spring material, to provide resilience.

The article 10 is put on the user's head 12 by slightly broadening 20 the space between the ear pieces 16 at the ends of the headband 14 so that the ear pieces 16 are brought in position adjacent the ears 11. When the article 10 is put onto the head 12, it is positioned in such a manner that the ear pieces 25 are pressed onto the user's head 12 and ears 11 by the resilience of the headband 14. In this way, the ears become sandwiched between the head 12 and the ear pieces 16. At the same time, the middle of the headband 14 comes into contact with the neck or collar of the wearer at the base 15 of the head region 20 of the user's head 12.

When this article 10 is used as described above, the ear pieces 30 16 are pressed to the head 12 as a result of the resilience of the headband 14. However, this structure does not enable active support by the ears 11 because its means of support is tension from the resilient material. In some designs it can be partially supported by the middle part of the headband 14 coming into contact with or riding on the base 15 of the user's head region 20 or the neck 19 or collar 21 at the side of the base 15 of the head region 20.

Unfortunately, when, for example, the headband 14 comes into contact with the neck 19 or collar 21 of the user's clothes, movement of the user's head 12 generates stress in the headband 14, thus stressing the entire structure. As a result, the position of the article 10 is frequently changed,

5 causing noise and discomfort, which affects an individual's ability to concentrate and hear. In addition, the resilience of the tensioned headband 14 forms a sealed cup around the ears, interfering with sound entering into the ear canal. Because there is no active ear support feature, the resilience in the headband 14 must be strong enough to prevent the ear protection device 10 from falling

10 off the head 12, causing unnecessary pressure to be exerted on the ears and the head 12, which can cause discomfort to the user. This discomfort is compounded when the level of sound the user can hear from beneath the ear pieces 16 is diminished. Thus, despite the existence of various types of earmuffs and headbands, there remains a need for an ear protection device

15 having the advantages of the present invention.

BRIEF SUMMARY OF THE INVENTION

The disclosed and claimed embodiments of the invention are directed to an ear protection device that includes a pair of ear protectors, each ear protector having an ear cup sized and shaped to be received over a user's ear, and a pocket associated with the ear cup that is sized and shaped to be received over the top of the user's ear and to support the device on the ear; and a band connected to the pair of ear protectors, the band formed of lightweight resilient material and configured to position the ear covers in alignment with the user's ears and with the pockets positioned over the tops of the respective ears.

20 Ideally, the band is sized and shaped to extend downward below the user's earlobe when worn by the user and to extend behind the user's head to leave an unobstructed space adjacent the top of the user's ear to accommodate glasses and headgear.

25

In accordance with another aspect of the present invention, the band can be configured to provide sufficient tension to hold the ear protector against the user's head to resist the entry of wind into the user's ear.

In accordance with another aspect of the present invention, each ear protector further includes an inside wall configured to bear against the user's ear, an outside wall adjacent the inside wall and separated by a hollow interior, a first opening formed in the inside wall communicating with the hollow

interior and a second opening formed in the outside wall that communicates with the hollow interior; the ear protector further including a cover mounted on the outside wall to selectively cover and uncover the second opening formed in the outside wall. The cover may be hingedly or slidably affixed to the outside
5 wall. Hearing can be further enhanced through the use of active amplifiers.

In accordance with yet another aspect of the foregoing embodiment of the invention, a pocket is formed, preferably of fabric material, that is associated with the ear cup that is sized and shaped to be received over the top of the user's ear. Ideally, the pocket is held in an opened configuration
10 by a ledge or protrusion formed on the ear cup over which the pocket is mounted. In one embodiment the ledge has a crescent shape that follows the curved contour of the ear cup

In accordance with another embodiment of the invention, a device for protecting the ears of a user is provided that includes covers for the ears, 15 the covers include a support for holding the covers on the top of the user's ears; a structure for positioning the covers over the ears so the supports are in alignment over the tops of the user's ears; and a structure for selectively covering and uncovering an opening in the ear cover to facilitate the hearing of the user when the covering structure is in an opened position wherein the
20 opening in the ear cover is unobstructed.

In accordance with yet another embodiment of the invention, a lightweight device for protecting the ears of a user and accommodating the use of headgear, including, but not limited to, glasses and hats, is provided. The lightweight device includes first and second ear protectors that are each sized
25 and shaped to be received over a respective ear of the user and further including a support configured to be received over the top of the user's ear to support the device on the user's ear; and a connection member associated with the first and second ear protectors and configured to position the first and second ear protectors adjacent the ears of a user with the supports aligned
30 over the top of the respective ear of the user, the connection member further configured to hold the first and second ear protectors against the head of the user with sufficient force to resist the entry of air between the ear protectors and the user's head when the user is moving through the air. Ideally, the connection member is configured to pass below the user's earlobes and behind
35 the user's head to facilitate the use of headgear on the user's head.

In accordance with another aspect of the foregoing embodiment, an opening is formed in each of the first and second ear protectors to facilitate the passage of sound from outside the ear protectors to the user's ear, and further comprising a door mounted to each ear protector, each door configured

- 5 to be selectively openable to facilitate the hearing of the user and closable to cover the opening in the ear protector. Ideally, the door is hingedly attached to the ear protector to swing forward into an opened configuration in a manner to deflect moving air away from the opening in the ear protector.

In accordance with another aspect of the foregoing embodiment, 10 the support on the ear protector comprises a fabric pocket sized and shaped to be slidably received over the top of the user's ear, each ear protector further comprising a ledge formed thereon that is sized and shaped to hold the pocket open to facilitate placement of the ear protector on the top of the user's ear.

In accordance with another aspect of the present invention, there 15 is provided an ear protection device that includes at least one ear cup with an ear rest that rests on top of an ear and a headband having flexibility and resilience to position the at least one ear cup in alignment with the user's ear.

In accordance with another aspect of the present invention, the components of the ear protection device are formed with semi-rigid material in a 20 generally semi-spherical configuration, with each ear cup having a concave inner surface. The internal elements consist of suitable materials to create comfortable warmth and protection for the ears. The ear cups are constructed or covered with an insulating material such as fabric, which by design requires minimal material and therefore reduces the amount of fabric and related sewing 25 required for construction. The device of the present invention may incorporate an acoustic device such as audio speakers, sound amplifiers, or similar type devices to create a combination ear protection device and headphone.

In accordance with a further aspect of the present invention, the 30 ear protection device includes an acoustic feature that acts as a passive amplifier by directing sound waves to travel through a path into the ear, allowing for hearing to be enhanced and minimally obstructed.

As will be readily appreciated from the foregoing, the ear 35 protection device features components that make the device easy and comfortable to wear while warming the ears. It is designed to utilize passive amplification of sound, and it has minimally obstructed hearing. The ear cups are pressed against the ear with a small amount of tension from a slightly

resilient headband. The ear cups are provided with ear rests having a support to come into contact with the top portion of the ear. When the ear cups are covered with a material such as fabric, the pocket combined with the ear rest and the resilience of the headband work together to ensure stability in wearing the
5 ear protection device.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

The foregoing features and advantages of the present invention will be more readily appreciated as the same become better understood from the accompanying drawings in which like elements have the same reference
10 numbers, wherein:

- Figure 1 is a side view of a prior device;
- Figure 2 is a side view of one embodiment of an ear protection device formed in accordance with the present invention;
- Figure 3 is an exploded isometric projection of the ear protection
15 device of Figure 2;
- Figure 4 is a top view of the ear protection device of Figure 3;
- Figure 5 is an enlarged side view of the ear protection device of
Figure 3;
- Figure 6 is a rear view of the ear protection device of Figure 3;
- 20 Figure 7 is an exploded isometric projection of an outer ear frame;
- Figures 8A-8E are right and left isometric views, a back view, a side view and a front view of a door, respectively; and
- Figure 9 is an exploded isometric view of an acoustic component
assembled into the ear protection device.

25 DETAILED DESCRIPTION OF THE INVENTION

Referring initially to Figure 2, shown therein is a side view illustration of a first embodiment of the ear protection device 18 formed in accordance with the present invention. The device 18, shown on the head 12 of a user, has ear protectors 23 connected to or integrally formed with a headband
30 22 that positions the ear protectors 23 adjacent to and in alignment with the ears (not shown in this view) of the user.

As shown more clearly in Figure 3, the device 18 includes outer ear frames 26 that are either connected to the frame 22 by an interlocking joint 24 or are integrally formed therewith and inner ear cups 28 attached to the ear

frames 26. The headband 22 is formed to have a semi-flat, elliptical shape, which in one embodiment connects to the outer ear frame 26 through the interlocking joint 24. The joint 24 includes connectors 40 and 42. The interlocking joint 24 is secured when the connectors 40 and 42 are fused 5 together through a process such as gluing or sonic welding.

The headband frame 22 is formed in a curved shape to fit the shape of a typical individual's head, and more particularly to fit the shape of the base 15 of the head region 20 of an individual's head 12. The overall shape of the headband 22 is approximately that of an omega (Ω). As shown in Figure 2, 10 the headband frame 22 is formed to curve in a lower direction overall so as to approximately run along the lower ends of ears, known commonly as the lobe of the ears. More particularly, the headband 22 is sized and shaped to extend downward below the user's earlobe when worn by the user and to extend behind the user's head 12 to leave an unobstructed space adjacent the top of 15 the user's ear to accommodate the use of headgear such as glasses, hats and helmets.

Referring to Figures 3-8, the ear frame 26 is formed to have a concave-shaped outer wall 38 that is, in this embodiment, substantially semi-circular in nature. It is to be understood that the shape can be other than semi- 20 circular. This built in concave shape is aerodynamically designed so that moving air is directed around the outer wall 38 of the ear protection device 18 rather than directed toward the user's ear. The ear cups 28 are formed with semi-rigid material in a generally spherical configuration, with each ear cup 28 having a concave inside surface 29 and a convex outside surface 31. The ear 25 cups 28 are formed of suitable materials to create comfortable warmth and protection for the ears such as fabric or soft moldable components such as plastic or silicone.

In one embodiment a material, such as fabric, is used to form ear pads 60. As shown in Figure 6, the ear pad 60 is sized and shaped to 30 stretch over, attach to, and cover each ear cup 28. As shown therein, the ear pad 60 has an elastic ring 62 formed on one side that slips over the ear cup 28. By design, the ear pads 60 require minimal fabric and therefore reduce the amount of fabric and related sewing required for construction.

The ear pads 60 include a component to support the device 18 35 on the top of the ear. As shown in Figure 6, the component comprises an ear pocket 64 that is formed along a portion of the ear pad 60 to have an opening

66 sized and shaped to slide over the top of the user's ear. When so positioned, the pocket 64 supports the device 18 on the ear of the user.

The ear cups 28 have a ledge or protrusion 44 extending outward over the inside surface 29 to aid in supporting the device on the user's ears and 5 to hold the pocket 64 open. Each protrusion 44 has a semi-circular shape and is formed on the upper rim 43 of the inside surface 29 of each ear cup 28. When fabric is used for the ear pads 60, the protrusions 44 work to keep ear pocket 62 on the ear pad 60 held in an opened configuration to facilitate slidable engagement with the top of the user's ear.

10 Referring to Figure 3, the ear cups 28 slide into the ear frames 26 and are firmly bonded through interlocking joints (not shown) in the ear cups 28, which slot and attach into keyed joints in the ear frame 26. Alternately, attachment can be accomplished through a known process such as gluing or ultrasonic welding. In the case where an insulating material, such as fabric, is 15 used for the ear pad 60, and when the outer ear frame 26 is fused to the concave ear cup 28, the fabric may be captured and secured between the ear frame 26 and the ear cups 28 to prevent the material from coming off.

The ear protection device 18 is firmly attached to the head 12 through the combination of the interior ear rests 44, with the ear pads 60 and 20 the ear pockets 64 that rest on top of the user's ears, thus supporting the weight of the ear protection device 18. In embodiments where weight is a factor, the headband 22 can be formed to assist in holding the device 18 to the user's head 12. When combined, the ear pocket 64 resting on top of the ear and the resilience of the headband frame 22 can work together to ensure stability in 25 wearing the ear protection device 18. Ideally, the resilience of the headband frame 22 does not tightly squeeze the ear protectors 23 tightly to the user's head 12. Rather, it positions the ear protectors 23 over the ears and against the head 12 only with enough force to prevent wind from entering the user's ears.

The ear cups 28 have an interior concave shape to follow the 30 raised shape of the user's ear to keep the ear protection device 18 in a comfortable stable position. The ear cups 28 are formed from the same lightweight material used to construct the headband 22 or from a lightweight material such as elastomer that is softer and more flexible than that of the headband 22 so as not to be affected by the individual differences in the 35 shapes of ears and so as to help alleviate the load when ear protection device

18 is worn. Ideally, the ear protection device 18 is formed of a flexible and resilient material, such as polypropylene.

In another embodiment, the ear protection device 18 can include at least one acoustically designed component that facilitates hearing. More 5 particularly, a passive amplifier is provided that facilitates the travel of sound waves through the ear protectors 23 and into the ear, allowing for hearing to be enhanced and minimally obstructed. In one embodiment, the device 18 includes a cover or door 30 formed on the exterior of the ear frame 26 to selectively cover and uncover a hollow interior formed between the ear frame 26 and the 10 ear cup 28. Sound waves are directed through the ear frame 26 and holes 46 formed in the ear cups 28 and into the ear. The door 30 has a concave shape that captures the sound waves and directs them through the holes 46 formed of varying sizes in the ear cups 28.

The door 30 may be mounted in a variety of ways to the ear frame 15 26. As shown in Figures 7 through 8A-E, the door 30 is secured with at least one hinge 32 that is built into the ear frame 26. The design of the hinge 32 enables selective positioning of the door 30 at predetermined degrees of opening (see Figure 4). The hinge 32 is built into the ear frame 26 and features a cylindrical post 52 onto which the door 30 is attached with at least one U- 20 shaped cut 54 (shown in Figures 8C and 8D). The cylindrical post 52 varies in diameter near the top and bottom thereof so as to keep the U-shaped cuts 54 in position and prevent them from sliding. The outer ear frame 32 also features a friction lock 58 that allows the door 30 to stay partially opened, and a positive stop in the form of a nob 56 on the post 52 that enables the door 30 to stay 25 completely open at a set position while preventing the door 30 from being pushed in further than desired.

Within the ear cups 28 there can be provided a housing 36, as shown in Figure 9, as a means for mounting an acoustical device 90, such as speakers or a hearing aid or amplifier. An electrical cord 92, may be connected 30 to the acoustic device 90, which is fastened in the acoustic housing 36 of the ear cups 28. The electrical cord 92 then passes within a groove (not shown) built into the headband frame 22 so as to hide the electrical cord 92.

In use, the ear protection device 18 is put on an individual's head 12 in the following manner: The user takes hold of the device 18 so as to 35 slightly widen the gap between the left and right ear protectors 23 while

sandwiching the head 12 so that the pockets 64 are positioned in alignment over the user's ears.

When the ear cups 28 come into contact with the top side of the ears, the user then releases the ear protection device 18, which has been 5 pushed slightly downwards so that the ear pockets 92 come into contact with and are received over the top of the ears. In doing so, the complete device 18 is positioned on and supported by the ears. The putting on of the ear protection device 18 is then complete (see Figure 2). If desired, the headband 22 can be formed to urge the ear protectors 23 against the user's head to prevent wind 10 from entering the user's ears.

All of the above U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification and/or listed in the Application Data Sheet, are incorporated herein by reference, in their entirety.

15 From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. For example, a sliding door can be used to selectively cover and uncover the holes 46. The embodiment of the ear 20 protection device 18 has been described as having separate components; however the components of the ear protection device can be integrally formed as a single unitary element. Accordingly, the invention is not limited except as by the appended claims.

CLAIMS

1. An ear protection device, comprising:

a pair of ear protectors, each ear protector comprising an ear cup sized and shaped to be received over a user's ear, and a pocket associated with the ear cup that is sized and shaped to be received over the top of the user's ear and to support the device on the ear; and

a band connected to the pair of ear protectors, the band comprising lightweight resilient material and configured to position the ear covers in alignment with the user's ears and with the pockets positioned over the tops of the respective ears.

2. The device of claim 1 wherein the band is sized and shaped to extend downward below the user's earlobe when worn by the user and to extend behind the user's head to leave an unobstructed space adjacent the top of the user's ear to accommodate headgear, including glasses and hats.

3. The device of claim 1 wherein the band is configured to provide tension to hold the ear protectors against the user's head with only sufficient force to resist the entry of wind into the user's ear.

4. The device of claim 1 wherein each ear protector further comprises an inside wall configured to bear against the user's ear, an outside wall adjacent the inside wall and separated by a hollow interior, a first opening formed in the inside wall communicating with the hollow interior and a second opening formed in the outside wall and communicating with the hollow interior, the ear protector further comprising a cover hingedly attached to the outside wall to selectively cover and uncover the second opening formed in the outside wall

5. The device of claim 1, further comprising an electronic speaker positioned in at least one of the ear protectors.

6. The device of claim 5 wherein the cover is configured to swing outward and forward to an opened position and to swing inward and coplanar with the outside wall to a closed position.

7. The device of claim 1 wherein the ear cup is formed to have a concave shape to follow the raised shape of the user's ear.

8. The device of claim 1 wherein the pocket is formed of fabric material attached to the ear cup.

9. The device of claim 8 wherein the pocket is held in an opened configuration to facilitate slidable engagement with the top of the user's ear.

10. The device of claim 9 wherein each ear protector comprises a ledge formed thereon that is configured to hold the pocket in the opened configuration.

11. The device of claim 10, further comprising an opening formed in the ear cup to facilitate the communication of sound into the user's ear from an exterior of the ear cup, and further comprising a cover hingedly attached to the ear cup to selectively swing between an opened configuration wherein the opening in the ear cup is substantially unobstructed, and a closed position wherein the opening in the ear cup is substantially covered.

12. A device for protecting the ears of a user, the device comprising:
means for covering the ears, the covering means comprising means for supporting the covering means on the top of the user's ears;
means for positioning the covering means over the ears with the supporting means in alignment with the top of the user's ears; and
means for selectively covering and uncovering an opening in the ear covering means to facilitate the hearing of the user when the selective covering means is in an opened position wherein the opening in the ear covering means is unobstructed.

13. The device of claim 12 wherein the positioning means is configured for urging the ear covering means against the user's head while leaving the area above the user's ear unobstructed.

14. The device of claim 12 wherein the supporting means comprises a pocket means having an opening sized and shaped to accommodate the top of the user's ear.

15. The device of claim 14 further comprising means for holding the pocket means in the opened configuration, the holding means formed on the ear covering means.

16. The device of claim 15 wherein the positioning means is configured to pass below the user's earlobes and behind the user's head to facilitate the use of headgear on the user's head.

17. A lightweight device for protecting the ears of a user and accommodating the use of headgear, including, but not limited to, glasses and hats, the device comprising:

first and second ear protectors, each ear protector sized and shaped to be received over a respective ear of the user, and further comprising a support configured to be received over the top of the user's ear to support the device on the user's ear; and

a connection member associated with the first and second ear protectors and configured to position the first and second ear protectors adjacent the ears of the user with the supports aligned over the top of the respective ear of the user, the connection member further configured to hold the first and second ear protectors against the head of the user with sufficient force to resist the entry of air between the ear protector and the user's head when the user is moving through the air.

18. The device of claim 17, further comprising an opening formed in each of the first and second ear protectors to facilitate the passage of sound from outside the ear protectors to the user's ear, and further comprising a door hingedly attached to each ear protector, each door configured to be selectively openable to facilitate the hearing of the user and closable to cover the opening in the ear protector, the door configured to swing forward into an opened configuration to deflect moving air away from the opening in the ear protector.

19. The device of claim 18 wherein the support on the ear protector comprises a fabric pocket sized and shaped to be slidably received over the top of the user's ear, each ear protector further comprising a ledge formed thereon that is sized and shaped to hold the pocket open to facilitate placement of the ear protector on the top of the user's ear.

20. An ear protection system, comprising a band having integrally formed ear protectors on first and second ends thereof, the band configured to position the first and second ear protectors in contact with the respective ears of the user with sufficient force to hold the ear protectors against the user's head and reduce the entry of wind into the user's ears, the band configured to extend downward below the earlobe of the user's ear and behind the user's head;

each ear protector sized and shaped to substantially cover the respective ear of the user, each ear protector further comprising an ear cup having a substantially concave shape to bear against the user's ear, and an ear frame attached to the ear cup and having an outer wall to define a hollow interior between the outer wall and the ear cup, the ear cup having an opening to provide communication between the hollow interior and the user's ear, and the outer wall having an opening to provide communication between the hollow interior and the exterior of the ear protector, the ear protector further comprising a door hingedly attached to the outer wall and configured to move between an opened position wherein the opening in the outer wall is substantially unobstructed to facilitate the hearing of the user and a closed position wherein the door covers the opening in the outer wall, the door configured to swing forward to deflect wind from the opening in the outer wall, and each ear protector further comprising a pocket formed on the ear cup that is sized and shaped to be slidably received over the user's ear to support the device on the top of the user's ear.

21. The device of claim 20 wherein the pocket is formed of fabric material and is held in an opened configuration by a ledge formed on the ear cup.

22. The device of claim 21 further comprising an electronic speaker positioned in at least one of the ear protectors.

23. The device of claim 21 wherein each ear protector is sized and shaped to provide unrestricted access to a space between the user's ear and the user's head to facilitate the use of headgear such as glasses and hats.

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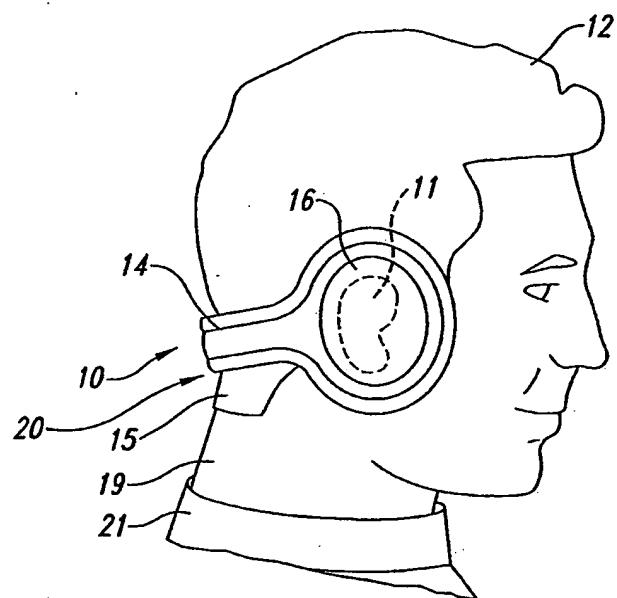


FIG. 1
(Prior Art)

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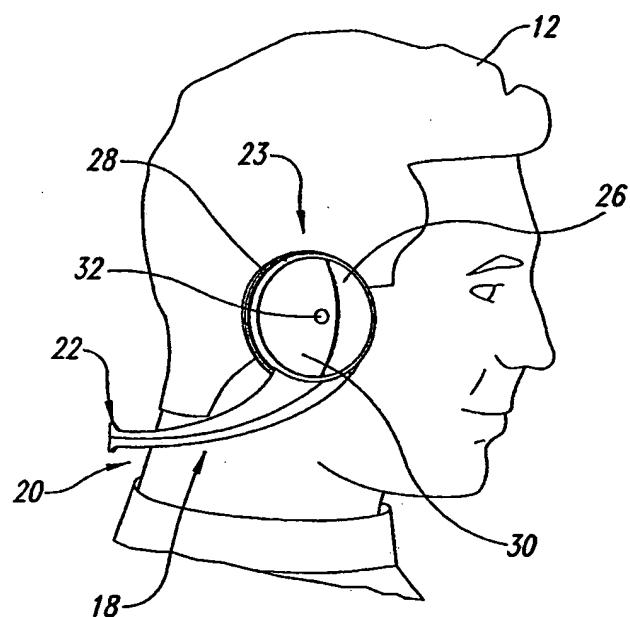


FIG. 2

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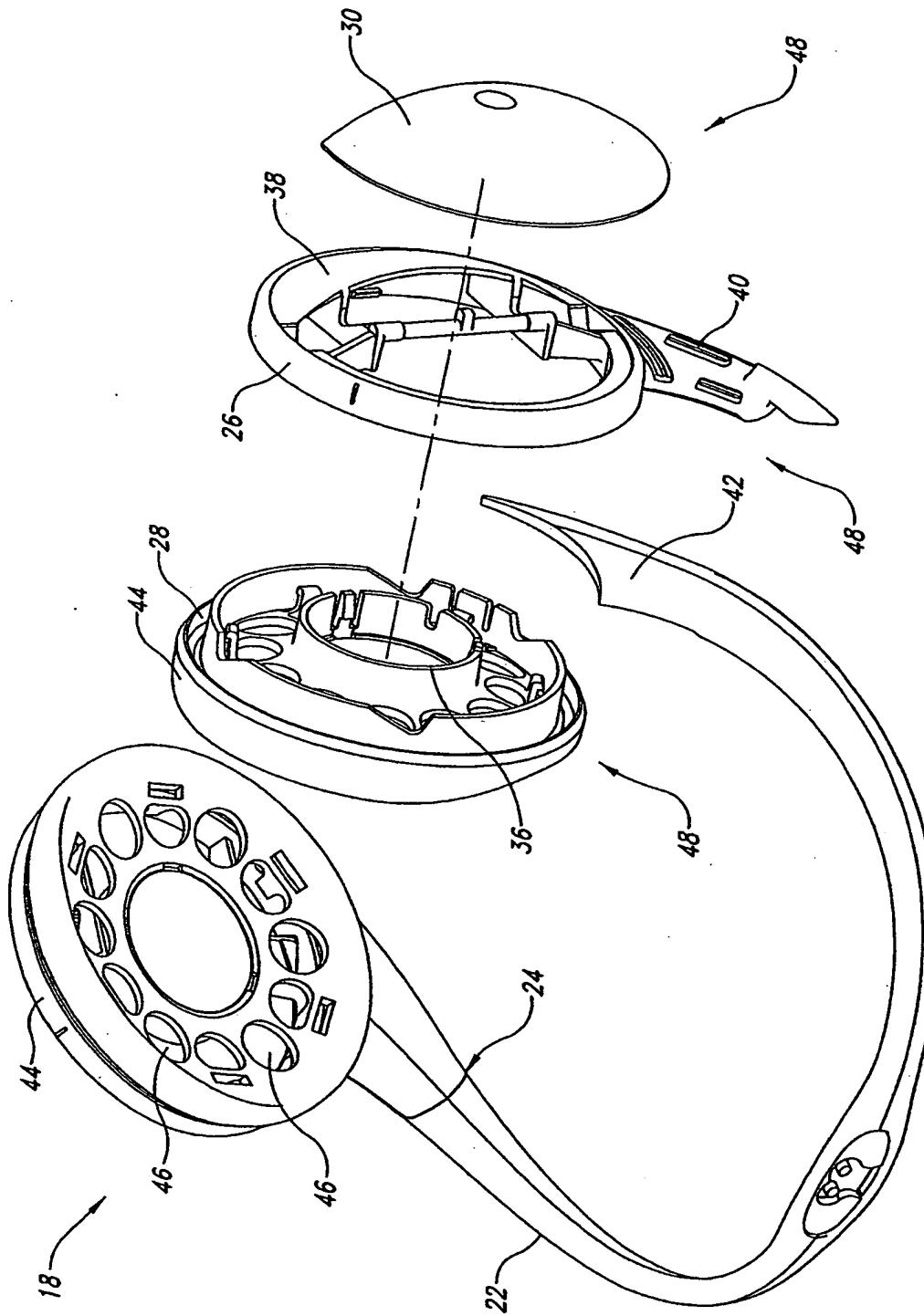


FIG. 3

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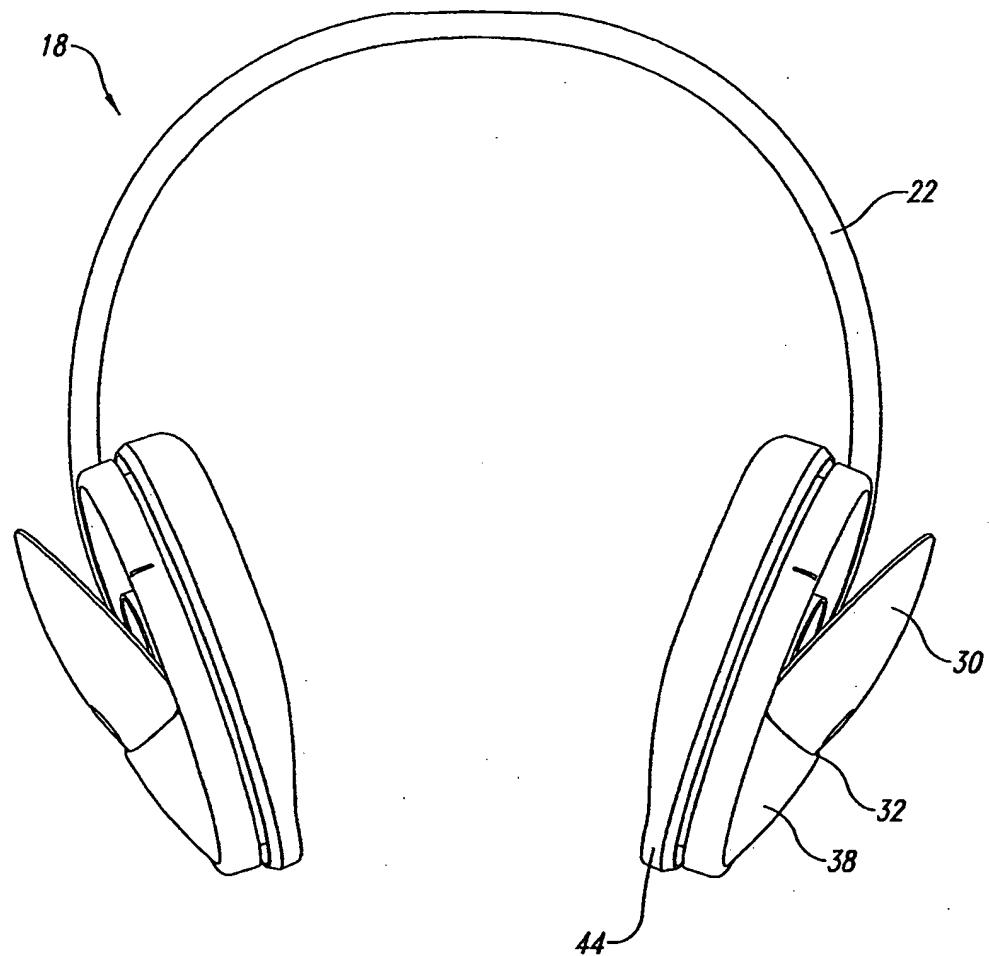


FIG. 4

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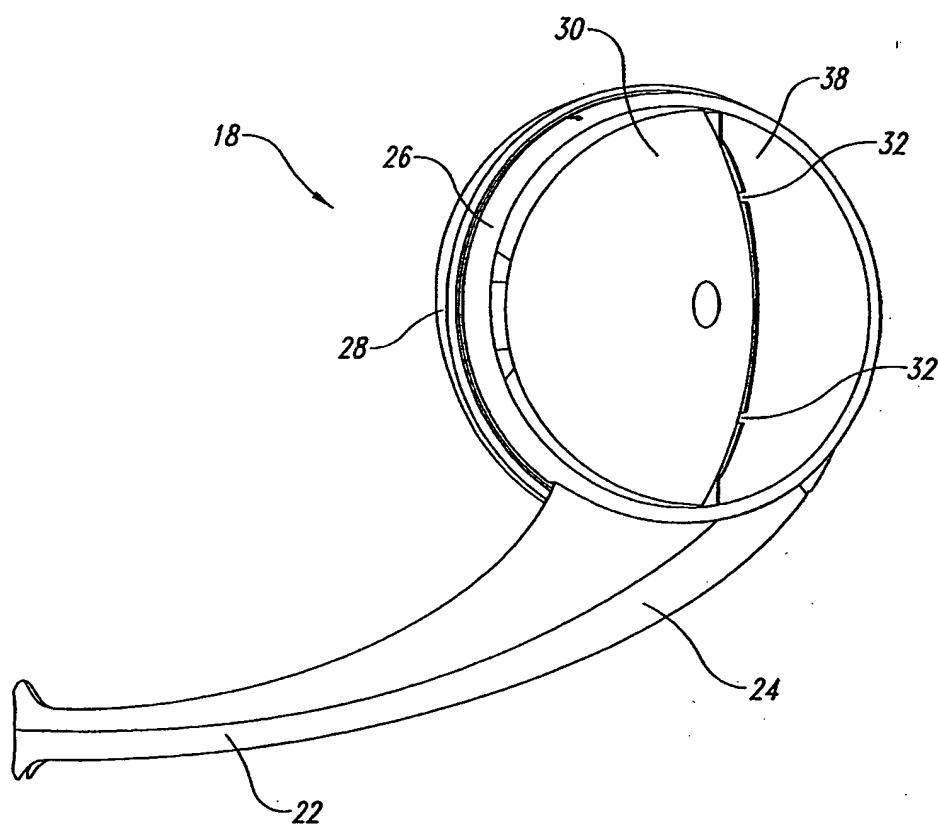


FIG. 5

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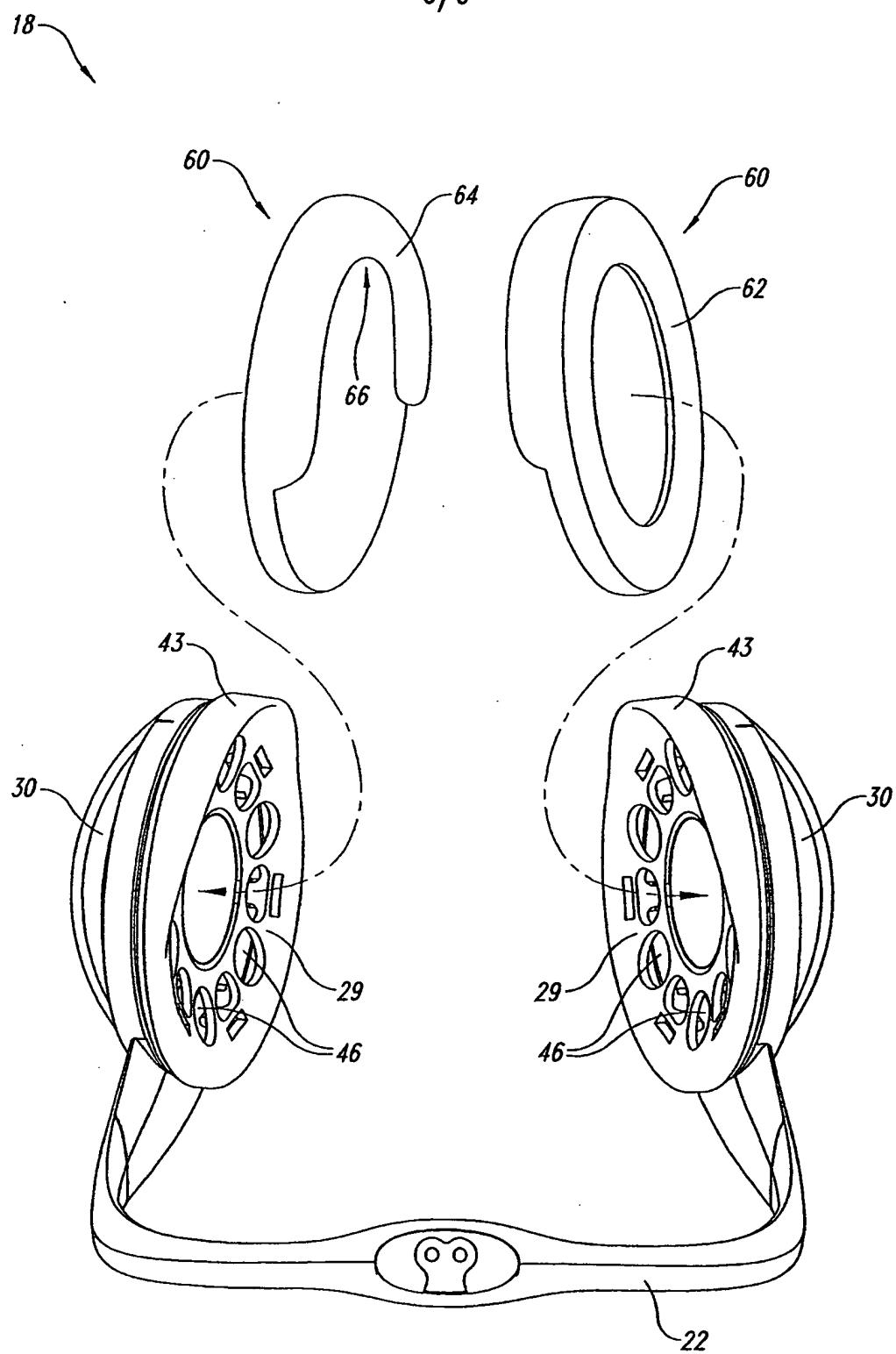


FIG. 6

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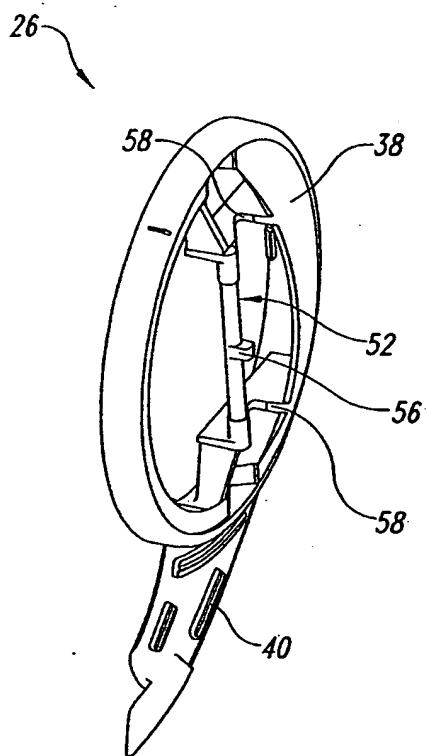


FIG. 7

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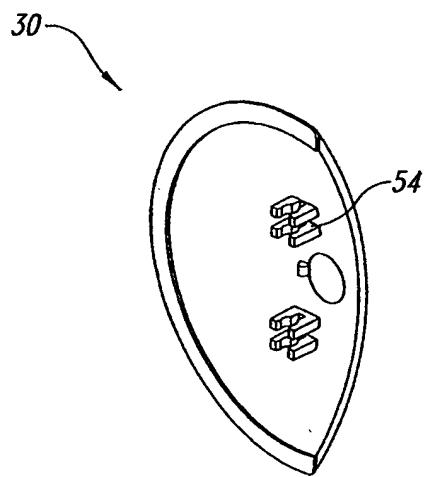


FIG. 8A

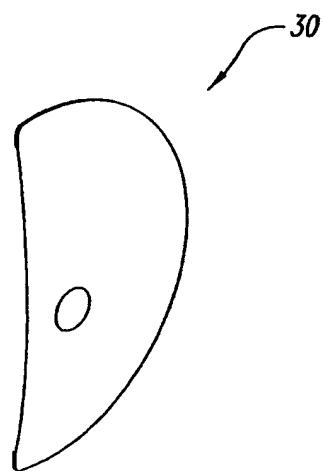


FIG. 8B

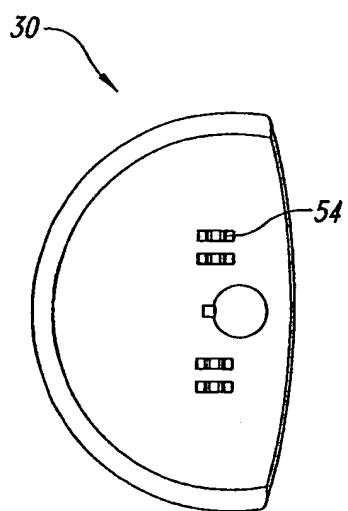


FIG. 8C

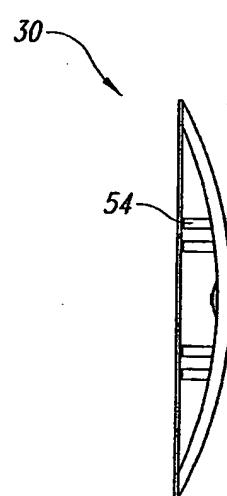


FIG. 8D

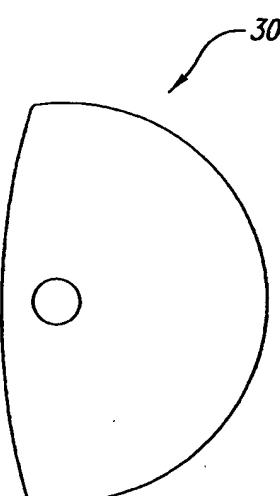


FIG. 8E

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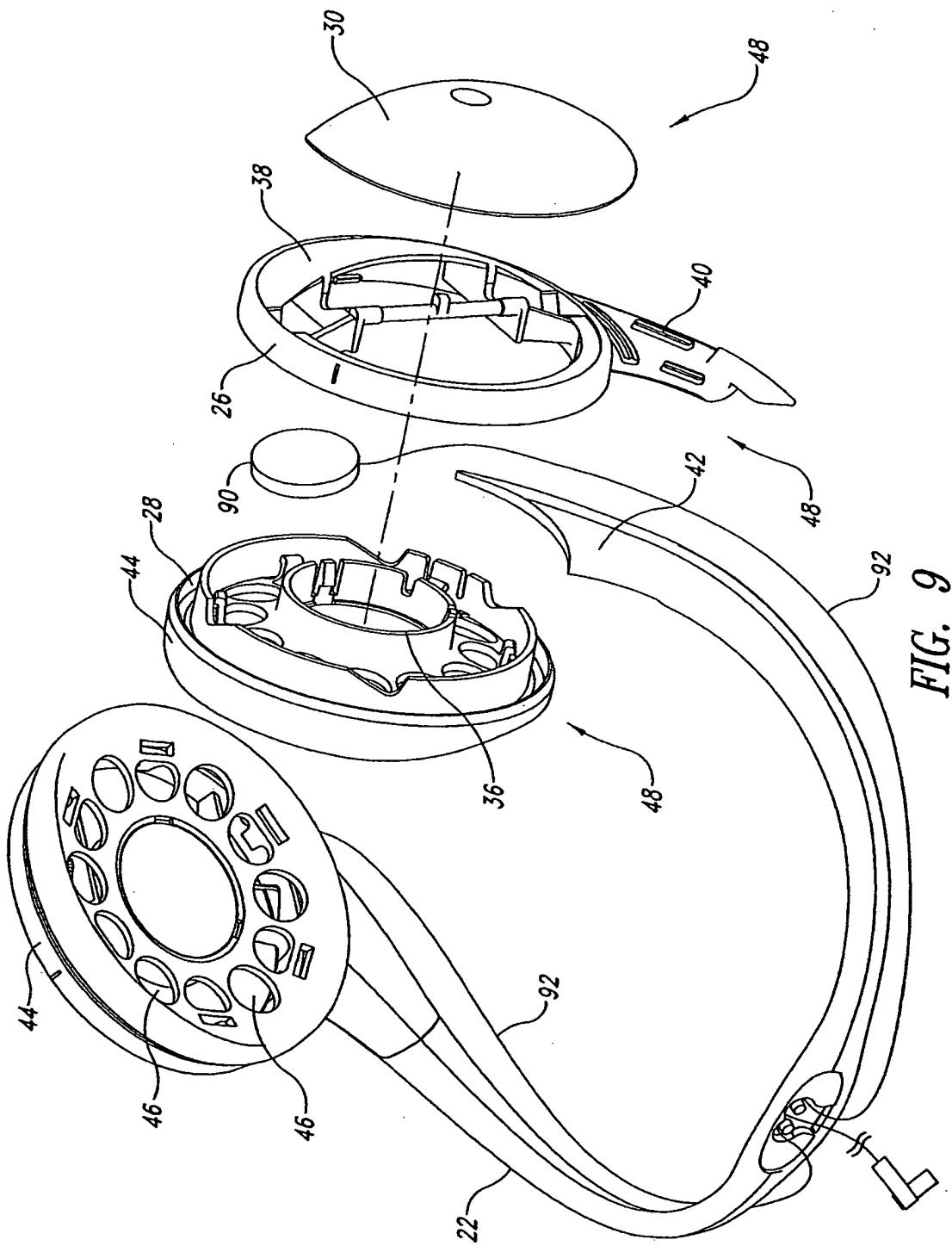


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/10903

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A42B 1/06; H04R 25/00
US CL : 2/209; 381/381

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 2/209, 423, Dig. 11; 381/381, 371, 373, 379, 378, 383; 128/864, 866, 867; 181/129, 133

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,673,438 A (LAMBERT) 07 October 1997 (07.10.1997), column 4, lines 19-23.	1-3, 7 and 17
A	WO 94/09734 A1 (SAKHAROV) 11 May 1994 (11.05.1994).	1-23
A	US 5,357,585 A (KUMAR) 18 October 1994 (18.10.1994).	1-23
A	US 2,899,683 A (WADSWORTH et al.) 18 August 1959 (18.08.1959).	1-23

Further documents are listed in the continuation of Box C. See patent family annex.

• Special categories of cited documents:	-T-	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
• A* document defining the general state of the art which is not considered to be of particular relevance	-X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
• E* earlier application or patent published on or after the international filing date	-Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
• L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	-&-	document member of the same patent family
• O* document referring to an oral disclosure, use, exhibition or other means		
• P* document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
26 August 2003 (26.08.2003)	2003
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230	Authorized officer Rodney M. Lindsey Telephone No. (703) 872-9301

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